# APPENDIX C: LANDFILL COVER DESIGN CHECKLIST

## C-1. Landfill Cover Design Checklist

The purpose of this checklist is to prompt the designer or reviewer to consider all aspects of design. All major areas of design are covered by the checklist. However, the designer or reviewer must refer to the narrative and other references for detailed design criteria.

*a*. *Predesign investigations*.

(1) Field surveys and record searches.

- Have existing documents (Remedial Investigation, Feasibility Study, etc.) been reviewed? Y__N__N/A__
- Have recent and historical aerial photographs or mapping been obtained? Y__N__N/A__
- Have design or as-built drawings of the site been obtained? Y__N__N/A__
- Has current topographic mapping of the site, preferably CADD generated with 1-ft (300-mm) contour intervals, been obtained? Y__N__N/A__
- Does topographic mapping identify all surface features (e.g. fences, trees, buildings, etc.)? Y__N__N/A__
- Have existing monitoring wells, piezometers, etc., been surveyed and have horizontal coordinates and vertical elevations been determined? Y__N__N/A__
- Has horizontal and vertical control been established and documented? Y__N__N/A__
- Have baseline instrumentation data been obtained? Y__N__N/A__
- Have utilities been researched, identified, located, and mapped? Y__N__N/A__
- Have boundary surveys been conducted for both the project site and impacted adjoining properties? Y__N__N/A__
- Has a property (deed) search of the site and adjoining property been performed? Y__N__N/A__
- Has access for off-site monitoring been secured? Y__N__N/A__

(2) Geological investigations.

- Have geologic hazards such as landslides and active faulting been identified? Y__N__N/A__
- Have the limits of the landfill and/or extent of contamination been determined? Y__N__N/A__
- Has material excavatability been evaluated? Y__N__N/A__

- Has landfill gas generation been investigated? Y__N__N/A__
- Has the landfill composition, including physical and chemical characteristics of the refuse, been determined? Y__N__N/A__
- Have landfill leachate levels, gradients, pathways, and exit locations been determined? Y__N__N/A__
- Have the chemical characteristics of the leachate been determined? Y__N__N/A__
- Have ground water conditions been evaluated including water levels, flow directions, and ground water chemistry? Y__N__N/A__
- Have the foundation soils been characterized? Y__N__N/A__
- Have on-site and/or off-site borrow sources been located and characterized? Y__N__N/A__

(3) Geotechnical laboratory requirements. Have the following laboratory soil tests been performed on representative soil samples from the site and/or borrow areas?

- Mechanical Analysis. Y__N__N/A__
- Hydrometer Analysis. Y__N__N/A__
- Atterberg Limits. Y__N__N/A__
- Moisture Content. Y__N__N/A__
- Proctor and/or relative density. Y__N__N/A__
- Permeability. Y__N__N/A__
- Density. Y__N__N/A__
- Dispersive Clay. Y__N__N/A__
- Consolidation. Y__N__N/A__
- Shear strength. Y__N__N/A__
- Has all borrow material been evaluated to ensure that it is free of contamination? Y__N__N/A__

*b*. *Cover system components*.

(1) Vegetative cover.

- Is a vegetative cover applicable at this site? Y__N__N/A__
- Are locally adapted perennial plants specified? Y__N__N/A__
- Will the roots disrupt the low-permeability layer? Y__N__N/A__
- Will plant density be sufficient to minimize soil erosion to no more than 0.45 $kg/m^2$ (2 tons per acre) per year as determined

by the Universal Soil Loss Equation? Y__N__N/A__

- Is the vegetation capable of surviving and functioning with little or no maintenance? Y__N__N/A__
- Do the contract documents adequately specify material and placement requirements? See guide specification CEGS-02935. Y__N__N/A__

(2) Armored cover.

- Is an armored cover applicable for this site? Y__N__N/A__
- Is the cover capable of controlling soil erosion to no more than 0.45 kg/$m^2$(2 tons per acre) per year as determined by the Universal Soil Loss Equations? Y__N__N/A__
- Have items such as durability, maximum particle size, and gradation of the material been considered? Y__N__N/A__

(3) Topsoil.

- Is a top soil layer applicable at this site? Y__N__N/A__
- Does the topsoil have a minimum thickness of 150 mm (6 in.)? Y__N__N/A__
- Is a medium textured soil specified for the top soil layer? Y__N__N/A__
- Is the topsoil representative of soils in the vicinity? Y__N__N/A__
- Is traffic compaction specified using low ground pressure equipment? Y__N__N/A__
- Is the final top slope, after allowance for settling and subsidence, no less than 3 percent to facilitate runoff? Y__N__N/A__

(4) Select fill.

- Is an appropriate soil type specified for the select fill layer? Y__N__N/A__
- Is the maximum particle size specified? Y__N__N/A__
- Is select fill material locally available? Y__N__N/A__
- Is the select fill layer a minimum (including the 150 mm [6 in.] of topsoil) of 610 mm (24 in.) in thickness or maximum frost depth, whichever is greater? Y__N__N/A__
- Is placement of select fill specified to proceed up the slope? Y__N__N/A__
- Is the maximum drop height specified? Y__N__N/A__
- Is the depth of the first layer specified? Y__N__N/A__
- Is traffic compaction using low ground pressure equipment specified? Y__N__N/A__

(5) Geotextile filter.

- Will a geotextile filter be used at this site? Y__N__N/A__
- Have the soil retention properties of the geotextile been evaluated? Y__N__N/A__
- Have the permittivity requirements for the geotextile been evaluated? Y__N__N/A__
- Has the long term compatibility of the geotextile been evaluated? Y__N__N/A__
- Has the survivability of the geotextile been evaluated? Y__N__N/A__
- Have the strength requirements of the geotextile and seams been evaluated? Y__N__N/A__
- Do the contract documents adequately specify material and installation requirements? See guide specification CEGS-02272. Y__N__N/A__

(6) Granular filter.

- Will a granular filter be used at this site? Y__N__N/A__
- Have material requirements been specified? Y__N__N/A__
- Has the piping criteria been satisfied? Y__N__N/A__
- Has the permeability criteria been satisfied? Y__N__N/A__
- Do the contract documents adequately specify material and installation requirements? Y__N__N/A__

(7) Geonet drainage layer.

- Will a geonet be used at this site? Y__N__N/A__
- Is the final slope, after allowance for settlement and subsidence, greater than 3 percent? Y__N__N/A__
- Does the geonet prevent head build-up in the select fill? Y__N__N/A__
- Do compatibility, compressive strength, or tensile strength need to be considered during design? Y__N__N/A__
- Do the contract documents adequately specify material and installation requirements? See guide specification CEGS-02273. Y__N__N/A__

(8) Granular drainage layer.

- Will a granular drain be used at this site? Y__N__N/A__
- Does the granular drainage layer prevent head build-up in the select fill? Y__N__N/A__

- Is the hydraulic conductivity of the drainage material greater than 1 x $10^{-2}$ cm/sec (ft/sec)? Y__N__N/A__
- Does the granular drainage layer have a minimum thickness of 300 mm (12 in.)? Y__N__N/A__
- Is the final slope, after allowance for settlement and subsidence, greater than 3 percent? Y__N__N/A__
- Do the contract documents adequately specify material and installation requirements? Y__N__N/A__

(9) Collection transportation system.

- Are drainage pipes sized and identified on the drawings? Y__N__N/A__
- Do the drainage layer collection points freely drain into perimeter ditches or natural drainage swales? Y__N__N/A__
- Are the outlets of the drainage pipes placed above the bottom of the perimeter collection trench to prevent clogging? Y__N__N/A__
- Have pipe material and installation requirements been adequately specified? Y__N__N/A__

(10) Geomembrane.

- Will a geomembrane be used at this site? Y__N__N/A__
- Does the membrane need to be textured? Y__N__N/A__
- Is the minimum allowable thickness 1.0 mm (40 mils)? Y__N__N/A__
- Do the contract documents adequately specify material and installation requirements? See guide specification CEGS-02271. Y__N__N/A__

(11) Low permeability clay layer.

- Will a clay layer be used at this site? Y__N__N/A__
- Is the entire clay layer designed so that it is below frost depth? Y__N__N/A__
- Is the clay layer a minimum of 600 mm (2 ft) in thickness? Y__N__N/A__
- Has a clay borrow source been identified and tested? Y__N__N/A__
- Do the contract documents adequately specify material and installation requirements? See guide specification CEGS-02443. Y__N__N/A__

(12) Geosynthetic clay liner.

- Will a GCL be used at this site? Y__N__N/A__
- Will regulators allow the use of a GCL at this site? Y__N__N/A__
- Do the contract documents adequately specify material and

installation requirements? See guide specification CEGS-02442. Y__N__N/A__

(13) Gas collection and removal system.

- Is a gas collection and removal system applicable at this site? Y__N__N/A__
- Have analyses been performed to determine the landfill gas types and emission rates? Y__N__N/A__
- Do vertical or lateral migration routes or barriers exist? Y__N__N/A__
- Have the state requirements for gas control and treatment been determined? Y__N__N/A__
- Are there nearby residences or structures (within 300 m (1,000 ft)) that could be adversely impacted by migration of landfill gases? Y__N__N/A__
- Are gas monitoring probes needed between the landfill and structures? Y__N__N/A__
- Is an active gas control system needed due to the volume of gas being generated? Y__N__N/A__
- Is a gas collection well system most appropriate for this site? Y__N__N/A__
- Is a gas collection blanket system most appropriate for this site? Y__N__N/A__
- Is a perimeter collection trench needed? Y__N__N/A__
- Is the granular collection layer at least 300 mm (12 in.) thick? Y__N__N/A__
- If a geosynthetic gas collection layer is used, does it have adequate flow capacity? Y__N__N/A__
- Are the vertical outlet vent pipes located at the highest elevation of a gas collection blanket? Y__N__N/A__
- Are slip couplings required? Y__N__N/A__
- Are the number of vent pipe penetrations minimized? Y__N__N/A__
- Are temporary vents required during construction to allow placement of select fill? Y__N__N/A__
- Are all components of the collection system compatible with the gas? Y__N__N/A__
- Is exposed piping for the gas collection system UV resistant? Y__N__N/A__
- Is a condensate collection system provided for the header piping? Y__N__N/A__
- Have material properties and placement procedures been specified for the gas collection system? Y__N__N/A__
- Is a monitoring schedule and contingency plan specified for

the collection system and monitoring probes? Y__N__N/A__

(14) Random fill and regraded refuse.

- Has a random fill borrow source been identified? Y__N__N/A__
- Have materials and placement requirements for random fill been specified? Y__N__N/A__
- Is a procedural method specified for placement of the initial lifts placed on the refuse material? Y__N__N/A__
- Is the refuse material to be regraded? Y__N__N/A__
- Has the excavatability of the refuse material been evaluated? Y__N__N/A__
- Have lift thickness, compaction, and daily cover requirements been specified for refuse regrading? Y__N__N/A__
- Have health and safety issues been addressed? Y__N__N/A__
- Have air monitoring and surface runoff control requirements for refuse regrading been specified? Y__N__N/A__
- Are compaction requirements specified for the landfill surface? Y__N__N/A__

*c*. *Geotechnical design*.

(1) Settlement analysis.

- Has consolidation of the refuse been evaluated? Y__N__N/A__
- Has consolidation of the foundation been evaluated? Y__N__N/A__
- After settlement, will the cover have a minimum slope of 3 percent? Y__N__N/A__

(2) Stability analysis.

- Were appropriate factors of safety used for stability analyses? Y__N__N/A__
- Has a stability analysis been performed on all cover interfaces? Y__N__N/A__
- Has a stability analysis of the waste fill mass and foundation been evaluated? Y__N__N/A__
- Have special conditions such as seismic and seepage forces been considered? Y__N__N/A__

(3) Test fill.

- Are test fill construction and testing criteria adequately specified? Y__N__N/A__

(4) Borrow areas.

- Have economical borrow sources been located and investigated for all cover component materials? Y__N__N/A__
- Have haul routes from the borrow sources been identified and evaluated? Y__N__N/A__
- Do the specifications require all borrow materials be tested for contamination? Y__N__N/A__

(5) Ground water monitoring.

- Have the regulatory requirements for ground water monitoring been defined? Y__N__N/A__
- Have existing wells been evaluated for for use as monitoring points? Do the specifications address existing monitoring wells that will be impacted by construction (i.e., abandonment, extension, etc.)? Y__N__N/A__
- Do the contract documents adequately specify material, installation and monitoring requirements? See guide specification CEGS-02671. Y__N__N/A__

(6) Final cover grading requirements.

- Have the regulatory requirements for grading been met? Y__N__N/A__

(7) Cover penetrations.

- Have the number of penetrations through barrier layers been minimized? Y__N__N/A__
- Are cover penetration requirements adequately addressed in the plans and specifications? Y__N__N/A__

(8) HELP model.

- Have HELP model runs been performed? Y__N__N/A__

(9) Leachate control.

- Has the leachate collection blanket been properly designed and specified? Y__N__N/A__

(10) Cover surface runoff and erosion control requirements.

- Have the State regulations for runoff and erosion been determined? Y__N__N/A__

- Have surface runoff and erosion control measures been properly designed and specified? Y__N__N/A__

(11) Terraces, drop structures and perimeter drainage controls.

- Has the site-specific hydrology and hydraulics been assessed to properly design the terraces, drop structures and perimeter drainage controls? Y__N__N/A__

(12) Off-site discharge control.

- Can gravity flow be used for off-site discharge? If not, has storage and pumping requirements been assessed? Y__N__N/A__

- Is a detention pond required to control releases of water and sediment? Y__N__N/A__

- Do off-site discharge control measures comply with state and local regulations? Y__N__N/A__

- Do the off-site discharge control measures require a Federal or state permit? Y__N__N/A__

(13) Floodplain considerations.

- Does the final cover encroach into the 100-year floodplain? Y__N__N/A__

- Will construction of the cap increase river stages? Y__N__N/A__

- Is a 404 permit required for construction of the landfill cover? Y__N__N/A__

- Are flood protection or stream bank erosion control measures required? Y__N__N/A__

*d*. *Civil design*.

- Have site access routes been addressed in the contract documents? Y__N__N/A__

- Are staging areas identified on contract documents? Y__N__N/A__

- Have phasing requirements been addressed in the contract documents? Y__N__N/A__

- Have utility requirements been specified? Y__N__N/A__
- Are decontamination pad design, operation and disposal requirements specified? Y__N__N/A__
- Are security fence requirements addressed in the contract documents? See guide specification CEGS-02831. Y__N__N/A__
- If structures are to be demolished, has an asbestos survey been conducted? Y__N__N/A__
- Has demolition and disposal been addressed in the contract documents? See guide specification CEGS-02050. Y__N__N/A__
- Are the limits of clearing and grubbing shown on the drawings? Y__N__N/A__
- Have grubbing requirements for the landfill surface been minimized? Y__N__N/A__
- Has disposal of cleared and grubbed material been addressed? Y__N__N/A__
- Has clearing and grubbing been addressed in the contract documents? See guide specification CEGS-02110. Y__N__N/A__

*e*. *Health and safety*.

- Have health and safety issues been addressed in the contract documents? See guide specification CEGS-01110. Y__N__N/A__

*f*. *Chemistry*.

- Have chemistry requirements been adequately addressed in the contract documents? See guide specification CEGS-01450. Y__N__N/A__

*g*. *Operation and maintenance requirements*.

- Have ground water and leachate monitoring criteria been addressed? Y__N__N/A__
- Have landfill gas control and monitoring issues been addressed? Y__N__N/A__
- Do the contract documents adequately address monitoring and inspection issues for the landfill cover and runoff control system? Y__N__N/A__
- Do the contract documents adequately address maintenance and repair issues for the landfill cover and runoff control system? Y__N__N/A__